PhytoKeys 157: 1–5 (2020)
doi: 10.3897/phytokeys.157.56842
http://phytokeys.pensoft.net

EDITORIAL

A peer-reviewed open-access journal
PhytoKeys
Launched to accelerate biodiversity research

Gesneriaceae in China and Vietnam: Perfection of taxonomy based on comprehensive morphological and molecular evidence

Wen-Hong Chen[1], Fang Wen[2], Ming-Xun Ren[3], Lihua Yang[4], Xin Hong[5], Zhi-Jing Qiu[6], Yu-Min Shui[1]

1 *CAS Key Laboratory for Plant Diversity and Biogeography of East Asia, Kunming Institute of Botany, Chinese Academy of Sciences, 132 Lanhei Road, CN-650201, Kunming, Yunnan Province, China* **2** *Gesneriad Conservation Center of China (GCCC) & Guangxi Key Laboratory of Plant Conservation and Restoration Ecology in Karst Terrain, Guangxi Institute of Botany, Guangxi Zhuang Autonomous Region and Chinese Academy of Sciences, Guilin, CN-541006, China* **3** *Center for Terrestrial Biodiversity of the South China Sea, College of Ecology and Environment, Hainan University, Haikou, CN-570228, China* **4** *Key Laboratory of Plant Resources Conservation and Sustainable Utilization, South China Botanical Garden, Chinese Academy of Sciences, Guangzhou, CN-510650, China* **5** *Anhui Provincial Engineering Laboratory of Wetland Ecosystem Protection and Restoration, School of Resources and Environmental Engineering, Anhui University, CN-230601, Hefei City, Anhui Province, China* **6** *Key Laboratory of Southern Subtropical Plant Diversity, Fairy Lake Botanical Garden, Shenzhen and Chinese Academy of Sciences, Shenzhen, CN-518004, China*

Corresponding author: Yu-Min Shui (ymshui@mail.kib.ac.cn)

Received 23 July 2020 | Accepted 4 August 2020 | Published 26 August 2020

Citation: Chen W-H, Wen F, Ren M-X, Yang L, Hong X, Qiu Z-J, Shui Y-M (2020) Gesneriaceae in China and Vietnam: Perfection of taxonomy based on comprehensive morphological and molecular evidence. In: Shui Y-M, Chen W-H, Ren M-X, Wen F, Hong X, Qiu Z-J, Wei Y-G, Kang M (Eds) Taxonomy of Gesneriaceae in China and Vietnam. PhytoKeys 157: 1–5. https://doi.org/10.3897/phytokeys.157.56842

Morphology is fundamental to taxonomy. Specimens in herbaria can provide unique supporting bases for scientific nomenclature. However, they usually reveal some limited variation of the taxa in nature and need to be revised gradually in future taxonomic studies. Because botanists make taxonomic treatments in herbaria without the benefit of molecular verification, many synonyms can occur. Traditionally, morphological treatment needs a combination of detailed herbaria work and extensive fieldwork. In general, the former work is usually dull, requires considerable patience, and tends to be neglected; this leads to unsubstantiated new synonyms. On the converse, field observa-

Copyright *Wen-Hong Chen et al.* This is an open access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

tions benefit from high-tech tools and equipment, which can reveal more delicate and detailed content in the field and the laboratory. These include detailed images directly from field observation by digital cameras, micro-morphology from SEM, and Vertical microscope work. In a word, the absence of detailed morphology from herbaria and the field cannot support good taxonomic work.

Diligent molecular work can support taxonomic revision. At the species level, molecular phylogeny seldom provides direct evidence to confirm a new species, but only tells us its affinities logically (Chen et al. 2014). Molecular evidence is not usually considered when new species are described. Although morphology seems to work in Gesneriaceae at the genus level, exceptions in morphology often happen, particularly with some of the expanded genera in Asia (*Oreocharis*, *Petrocodon*, and *Primulina*) (Figure 1; Möller et al. 2011; Wang et al. 2011; Weber et al. 2011a, b). In such cases, molecular evidence is helpful for accurate taxonomic treatment. However, the next crucial question will be how many DNA sequences will support the well-resolved relationships of the taxa above the species level. Based on the recent study, it seems to be that the combination of ITS and *trn*L-F is not enough to resolve the relationship within the above expanded genera. In special cases, we strongly suggest adopting more sequences to issue the taxonomic revision in the future study of Gesneriaceae (Chen et al. 2020), such as *atp*B-*rbc*L, *ndh*H-*rps*15-*ycf*1, *rpl*132, *trn*C-*trn*D, *trn*L-F, *trn*T-trnL of chloroplast DNA.

Some detailed rules are suggested during taxonomic revision in Gesneriaceae. First, the new species' establishment is usually based on morphological differences, with at least two or more different characteristics in diagnosis. It would be better to provide the key to the new species suggested and their related groups and species. Second, the comprehensive observation of morphology is necessary to support the new species, such as staminodes, discs of flowers, and the abaxial surface of leaves. Third, statistical analysis of morphological characters using sufficient samples from multiple populations can provide unbiased evidences for the taxonomic treatment of some species with subtle morphological differences (e.g. Yang et al. 2019). Fourth, chromosomes and pollen grains are important to the taxonomic revision and are strongly encouraged (Pan 1987; Yang et al. 2020). Lastly, more DNA sequences such as *atp*B-*rbc*L, *ndh*H-*rps*15-*ycf*1, *rpl*132, *trn*C-*trn*D, *trn*L-F, *trn*T-trnL, *psb*A-*trn*H than should be considered during the taxonomic treatment together with ITS (Qiu et al. 2015; Roalson and Roberts 2016; Chen et al. 2020).

This special issue focuses on China and Vietnam: an essential center of biodiversity worldwide (Myers et al. 2000). Gesneriaceae includes more than 700 accepted species in the area, and thus provides a suitable example for answering the above taxonomic questions (Ho 2000; Myers et al. 2000; Wen et al. 2019). Tan et al. (2020) offer an in-depth look at the updated taxonomy and biogeographical patterns of Asian Gesneriaceae. Hainan Island, one of the biggest islands in China and Vietnam, harbours an extremely high endemism ratio of Gesneriaceae and all *Oreocharis* species on this island are endemic (Ling et al. 2017). With an extensive examination combining both morphological and molecular evidences, Ling et al. (2020a, b) explored the taxonomical treatment of Hainan *Oreocharis* and found a possible new species. In addition to the numerous new species' taxonomic treatments referred to, several studies in this special issue emphasize the use of comprehensive morphological observation and more mo-

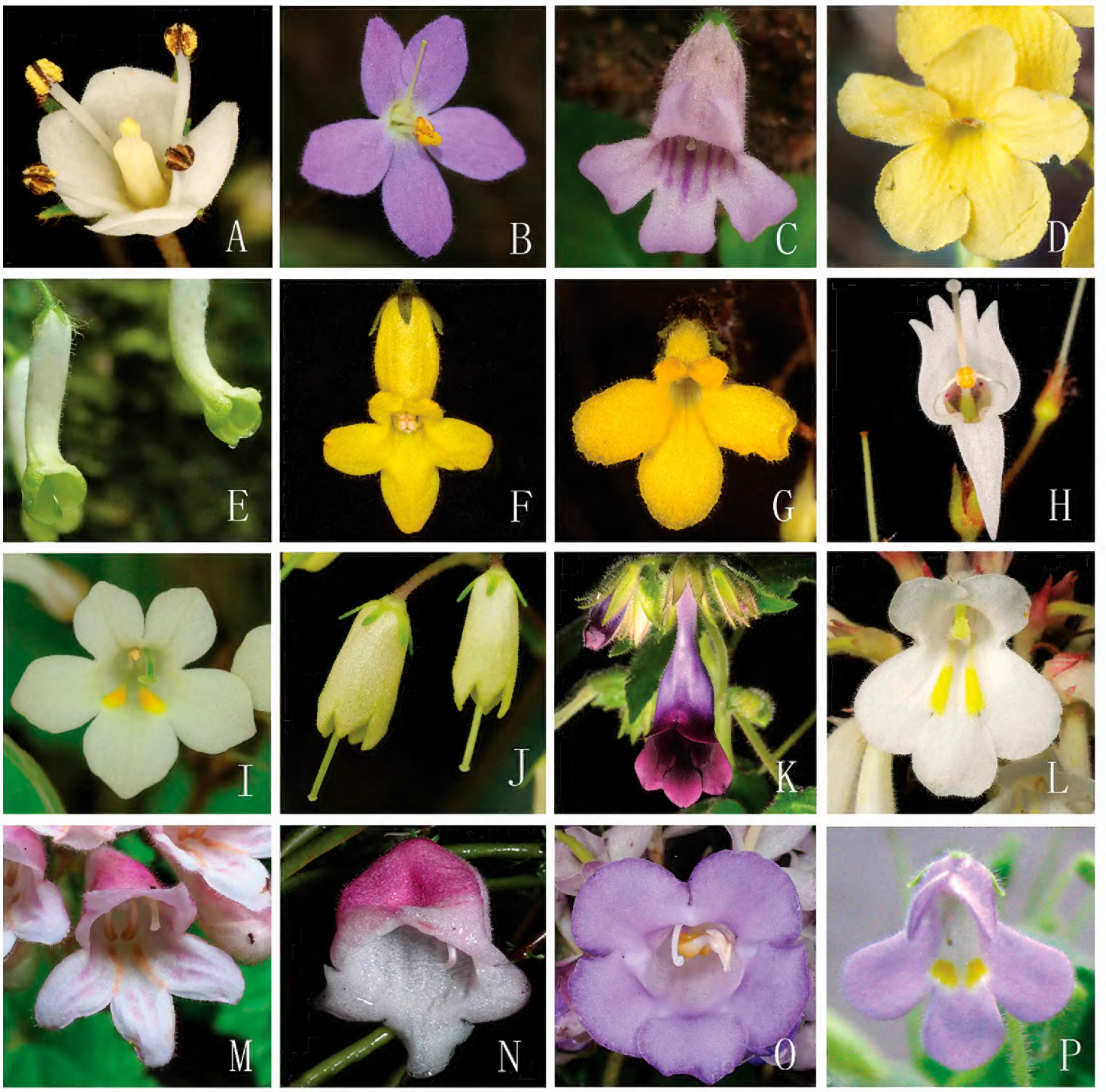

Figure 1. Flowers of some species of Gesneriaceae in China and Vietnam **A** *Bournea sinensis* Oliv. (photographed by Yu-Min Shui) **B** *Oreocharis guileana* (B.L. Burtt) Li H. Yang & F. Wen, comb. nov. (by Li-Hua Yang) **C** *Oreocharis baolianis* (Q.W. Lin) Li H. Yang & M. Kang, comb. nov. (by Li-Hua Yang) **D** *Oreocharis jasminina* S.J.Ling, F.Wen & M.X. Ren, sp. nov. (by Shao-Jun Ling) **E** *Oreocharis flavovirens* Xin Hong (by Xin Hong) **F** *Oreocharis wumengensis* Lei Cai & Z.L.Dao, sp. nov. (by Lei Cai) **G** *Oreocharis fulva* W.H.Chen & Y.M.Shui, sp. nov. (by Yu-Min Shui) **H** *Allocheilos rubroglandulosus* W.H. Chen & Y.M. Shui, sp. nov. (by Yu-Min Shui) **I** *Petrocodon rubiginosus* Y.G.Wei & R.L.Zhang, sp. nov. (by Fang Wen) **J** *Petrocodon luteoflorus* Lei Cai & F. Wen, sp. nov. (by Fang Wen) **K** *Deinostigma fasciculatum* W.H.Chen & Y.M.Shui, sp. nov. (by Yu-Min Shui) **L** *Primulina xuansonensis* W.H.Chen & Y.M.Shui, sp. nov. (by Yu-Min Shui) **M** *Didymocarpus lobulatus* F. Wen, Xin Hong &W.Y. Xie, sp. nov. (by Jia-Jun Zhou) **N** *Paraboea myriantha* Y.M. Shui & W.H. Chen, sp. nov. (by Yu-Min Shui) **O** *Paraboea sinensis* var. *glabrissima* W.H.Chen & Y.M.Shui, var. nov. (by Yu-Min Shui) **P** *Petrocosmea nanchuanensis* Z.Y. Liu, Z.Y. Li & Z.J. Qiu, sp. nov. (by Zhi-Jing Qiu).

lecular data to provide convincing conclusions. It would be desirable that all discoveries and taxonomic revisions will be conducted under these strict criteria suggested here in the future.

Acknowledgments

We are indebted to Dr. Yasen Mutafchiev, Dr. Eberhard Fischer, Prof Ming Kang, Prof. Yi-Gang Wei, Stephen Maciejewski (The Gesneriad Society), and Michael LoFurno (Adjunct Professor, Temple University, Philadelphia PA, USA), for their editorial assistance. Thanks also to Professors Michael Möller (Royal Botanic Gardens, Edinburgh) and Leonid V. Averyanov (Botanical Institute of the Russian Academy of Science, Russia) for their constructive suggestions. We additionally thank Mr. Shao-Jun Ling, Mr. Lei Cai, Mr. Jia-Jun Zhou, Ms. Qiu-Ping Chen for the preparation of figure. The publication of this special issue is supported by Biodiversity background survey and assessment project of Ministry of Ecology and Environment of the People's Republic of China and Monitoring program of the Hekou Field Station of tropical karst ecosystem (2020-YN-06).

References

Chen WH, Shui YM, Yang JB, Wang H, Nishii K, Wen F, Zhang ZR, Möller M (2014) Taxonomic status, phylogenetic affinities and genetic diversity of a presumed extinct genus, *Paraisometrum* W.T. Wang (Gesneriaceae) from the karst regions of Southwest China. PLoS One 9(9): E107967. https://doi.org/10.1371/journal.pone.0107967

Chen W-H, Zhang Y-M, Guo S-W, Zhang Z-R, Chen L, Shui Y-M (2020) Reassessment of *Bournea* Oliver (Gesneriaceae) based on molecular and palynological evidence. In: Shui Y-M, Chen W-H, Ren M-X, Wen F, Hong X, Qiu Z-J, Wei Y-G, Kang M (Eds) Taxonomy of Gesneriaceae in China and Vietnam. PhytoKeys 157: 27–41. https://doi.org/10.3897/phytokeys.157.55254

Ho TT (2000) Gesneriaceae. In: Ho PH (Ed.) An Illustrated Flora of Vietnam Vol. 3. Youth Publishing, Ho Chi Minh City, 12–29.

Ling SJ, Meng QW, Tang L, Ren MX (2017) Gesneriaceae on Hainan Island: distribution patterns and phylogenetic relationships. Biodiversity Sciences 25: 807–815. https://doi.org/10.17520/biods.2016360

Ling S-J, Guan S-P, Wen F, Shui Y-M, Ren M-X (2020) *Oreocharis jasminina* (Gesneriaceae), a new species from mountain tops of Hainan Island, South China. In: Shui Y-M, Chen W-H, Ren M-X, Wen F, Hong X, Qiu Z-J, Wei Y-G, Kang M (Eds) Taxonomy of Gesneriaceae in China and Vietnam. PhytoKeys 157: 121–135. https://doi.org/10.3897/phytokeys.157.50246

Ling S-J, Qin X-T, Song X-Q, Zhang L-N, Ren M-X (2020) Genetic delimitation of *Oreocharis* species from Hainan Island. In: Shui Y-M, Chen W-H, Ren M-X, Wen F, Hong X, Qiu Z-J, Wei Y-G, Kang M (Eds) Taxonomy of Gesneriaceae in China and Vietnam. PhytoKeys 157: 59–81. https://doi.org/10.3897/phytokeys.157.32427

Möller M, Middleton D, Nishii K, Wei YG, Sontag S, Weber A (2011) A new delineation for *Oreocharis* incorporating an additional ten genera of Chinese Gesneriaceae. Phytotaxa 23(1): 1–36. https://doi.org/10.11646/phytotaxa.23.1.1

Myers N, Mittermeier RA, Mittermeier CG, Fonseca GABD, Kent J (2000) Biodiversity hotspots for conservation priorities. Nature 403(6772): 853–858. https://doi.org/10.1038/35002501

Pan KY (1987) Taxonomy of the genus *Oreocharis* (Gesneriaceae). Acta Phytotaxonomica Sinica 25: 264–293.

Qiu ZJ, Lu YX, Li CQ, Dong Y, Smith JF, Wang YZ (2015) Origin and evolution of *Petrocosmea* (Gesneriaceae) inferred from both DNA sequence and novel findings in morphology with a test of morphology-based hypotheses. BMC Plant Biology 15(1): 167. https://doi.org/10.1186/s12870-015-0540-3

Roalson EH, Roberts WR (2016) Distinct processes drive diversification in different clades of Gesneriaceae. Systematic Biology 65(4): 662–684. https://doi.org/10.1093/sysbio/syw012

Tan K, Lu T, Ren M-X (2020) Biogeography and evolution of Asian Gesneriaceae based on updated taxonomy. In: Shui Y-M, Chen W-H, Ren M-X, Wen F, Hong X, Qiu Z-J, Wei Y-G, Kang M (Eds) Taxonomy of Gesneriaceae in China and Vietnam. PhytoKeys 157: 7–26. https://doi.org/10.3897/phytokeys.157.34032

Wang YZ, Mao RB, Liu Y, Li JM, Dong Y, Li ZY, Smith JF (2011) Phylogenetic reconstruction of *Chirita* and allies (Gesneriaceae) with taxonomic treatments. Journal of Systematics and Evolution 49(1): 50–64. https://doi.org/10.1111/j.1759-6831.2010.00113.x

Weber A, Middleton DJ, Forrest A, Kiew R, Lim CL, Rafidah AR, Sontag S, Triboun P, Wei YG, Yao TL, Möller M (2011a) Molecular systematics and remodeling of *Chirita* and associated genera (Gesneriaceae). Taxon 60(3): 767–790. https://doi.org/10.1002/tax.603012

Weber A, Wei YG, Puglisi C, Wen F, Mayer V, Möller M (2011b) A new definition of the genus *Petrocodon* (Gesneriaceae). Phytotaxa 23(1): 49–67. https://doi.org/10.11646/phytotaxa.23.1.3

Wen F, Li S, Xin ZB, Fu LF, Hong X, Cai L, Qin JQ, Pan B, Pan FZ, Wei YG (2019) The updated plant list of Gesneriaceae in China under the New Chinese Naming Rules. Guangxi Sciences 26(1): 37–63.

Yang LH, Kong HH, Huang JP, Kang M (2019) Different species or genetically divergent populations? Integrative species delimitation of the *Primulina hochiensis* complex from isolated karst habitats. Molecular Phylogenetics and Evolution 132: 219–231. https://doi.org/10.1016/j.ympev.2018.12.011

Yang L-H, Wen F, Kong H-H, Sun Z-X, Su L-Y, Kang M (2020) Two new combinations in *Oreocharis* (Gesneriaceae) based on morphological, molecular and cytological evidence. In: Shui Y-M, Chen W-H, Ren M-X, Wen F, Hong X, Qiu Z-J, Wei Y-G, Kang M (Eds) Taxonomy of Gesneriaceae in China and Vietnam. PhytoKeys 157: 43–58. https://doi.org/10.3897/phytokeys.157.32609